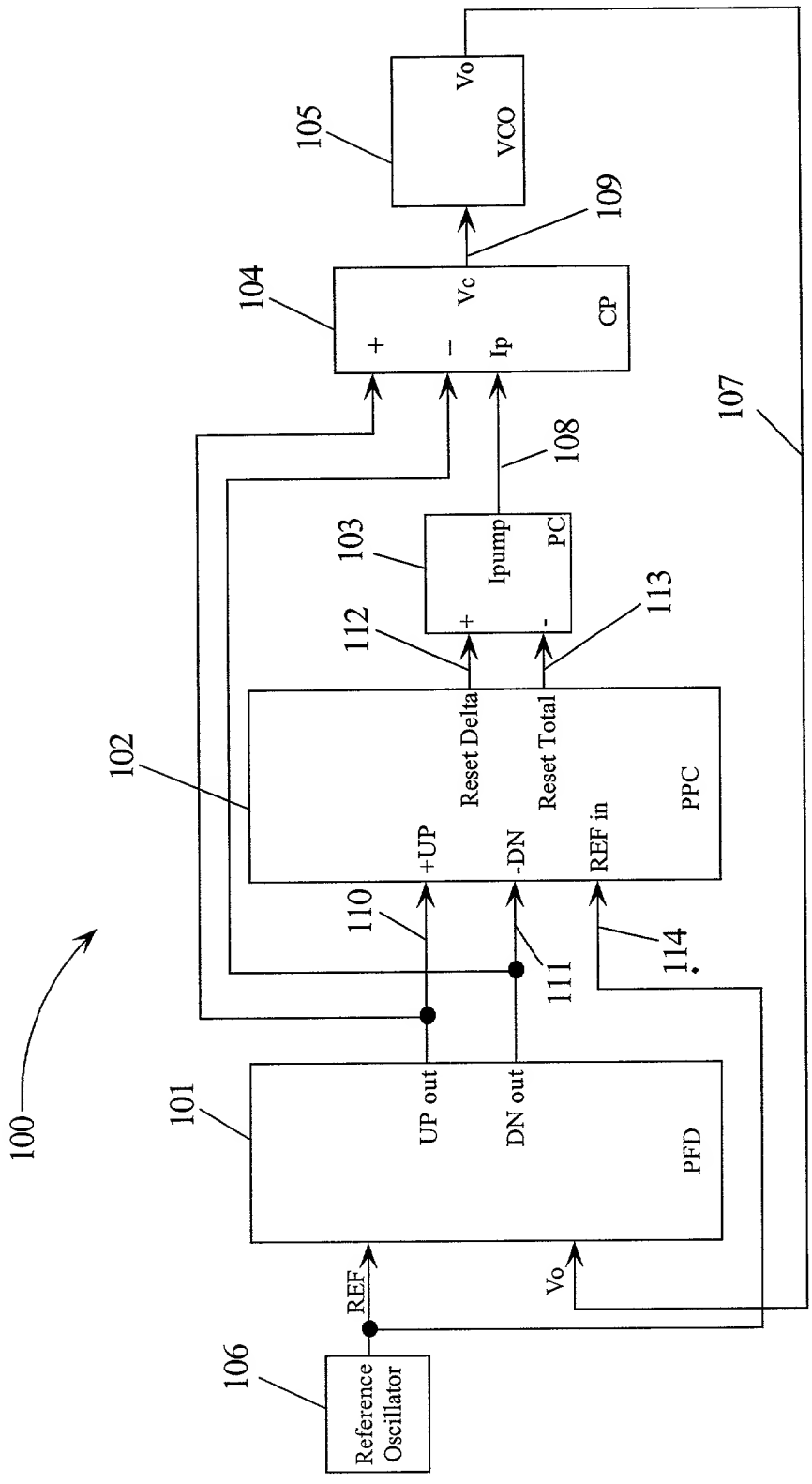
100
101
PFD
UP out
DN out
102
PPC
Reset Delta
Reset Total
REF in
+UP
-DN
103
Ipump
PC
104
CP
Vc
Ip
105
VCO
Vo
106
Reference Oscillator
REF
107
108
109
110
111
112
113
114

FIG. 1

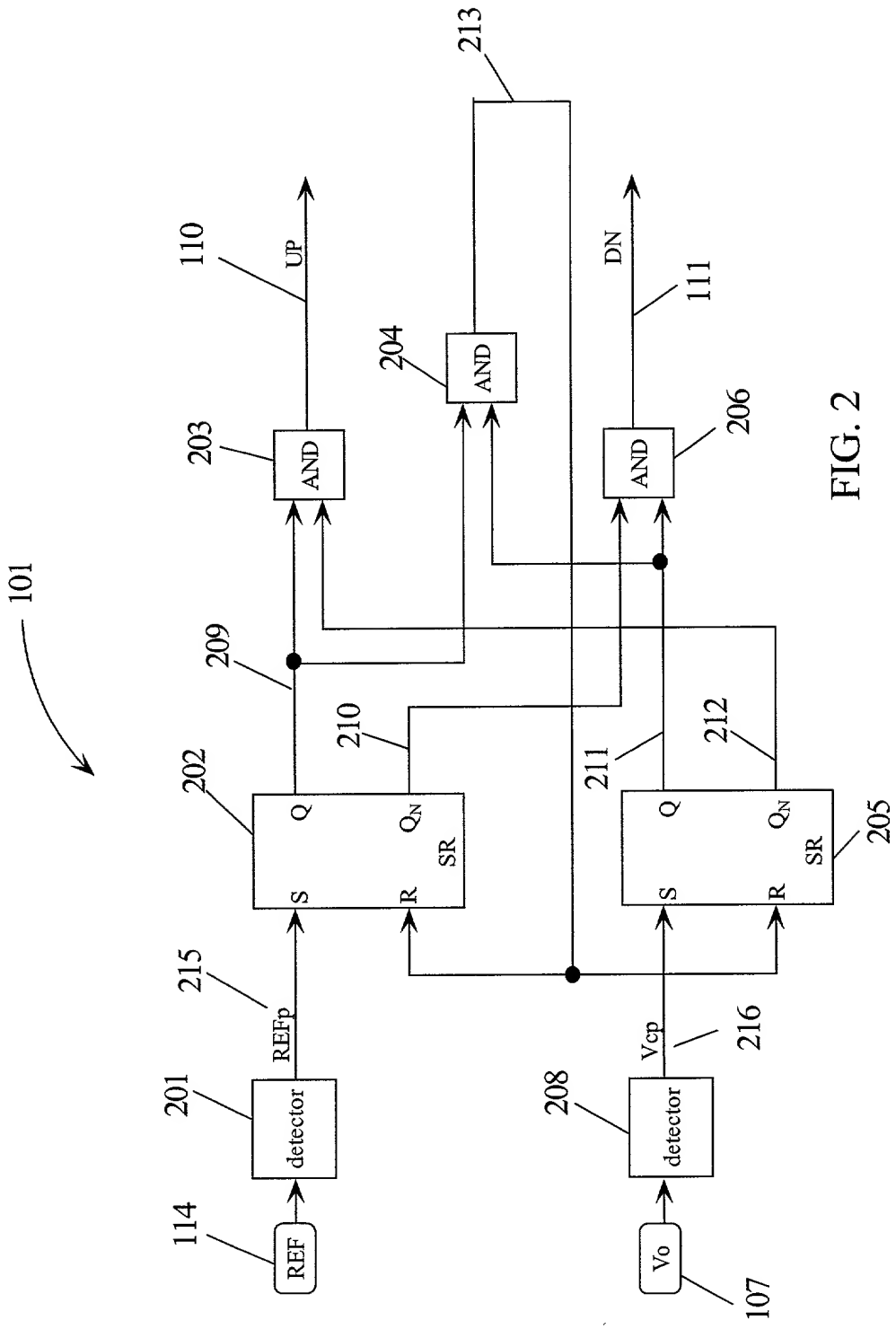
101
110
UP
213
204
AND
203
AND
DN
111
206
AND
209
210
211
212
202
Q
Q_N
SR
S
R
205
215
REFp
216
Vcp
201
detector
208
detector
114
REF
Vo
107

FIG. 2

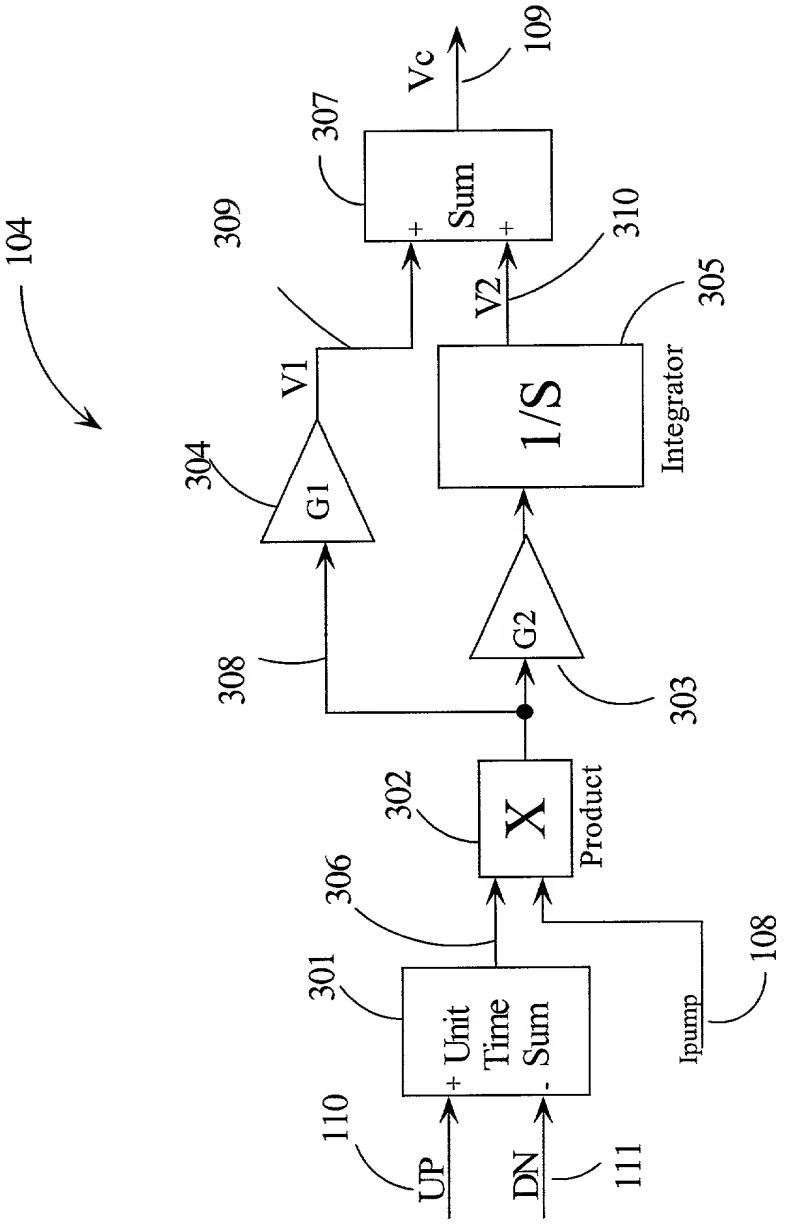
104
109
Vc
307
Sum
309
310
V2
305
Integrator
1/S
V1
304
G1
G2
308
303
302
X
Product
306
301
+ Unit Time Sum -
110
UP
DN
111
Ipump
108

FIG. 3

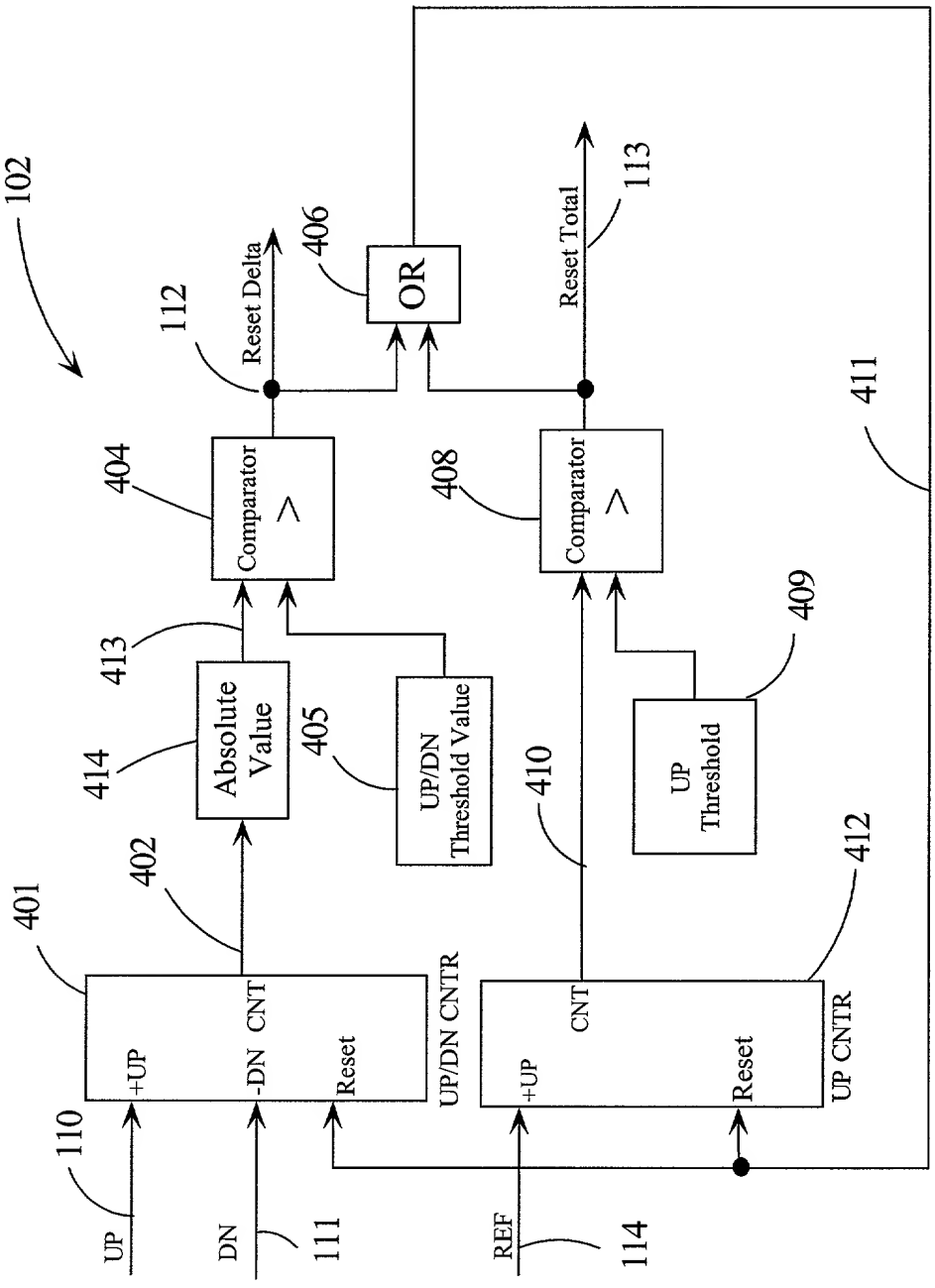
102
112
Reset Delta
406
OR
Reset Total
113
411
404
Comparator
>
408
Comparator
>
413
409
414
Absolute Value
405
UP/DN Threshold Value
410
UP Threshold
401
402
412
+UP
-DN
CNT
Reset
UP/DN CNTR
+UP
CNT
Reset
UP CNTR
110
UP
DN
111
REF
114

FIG. 4

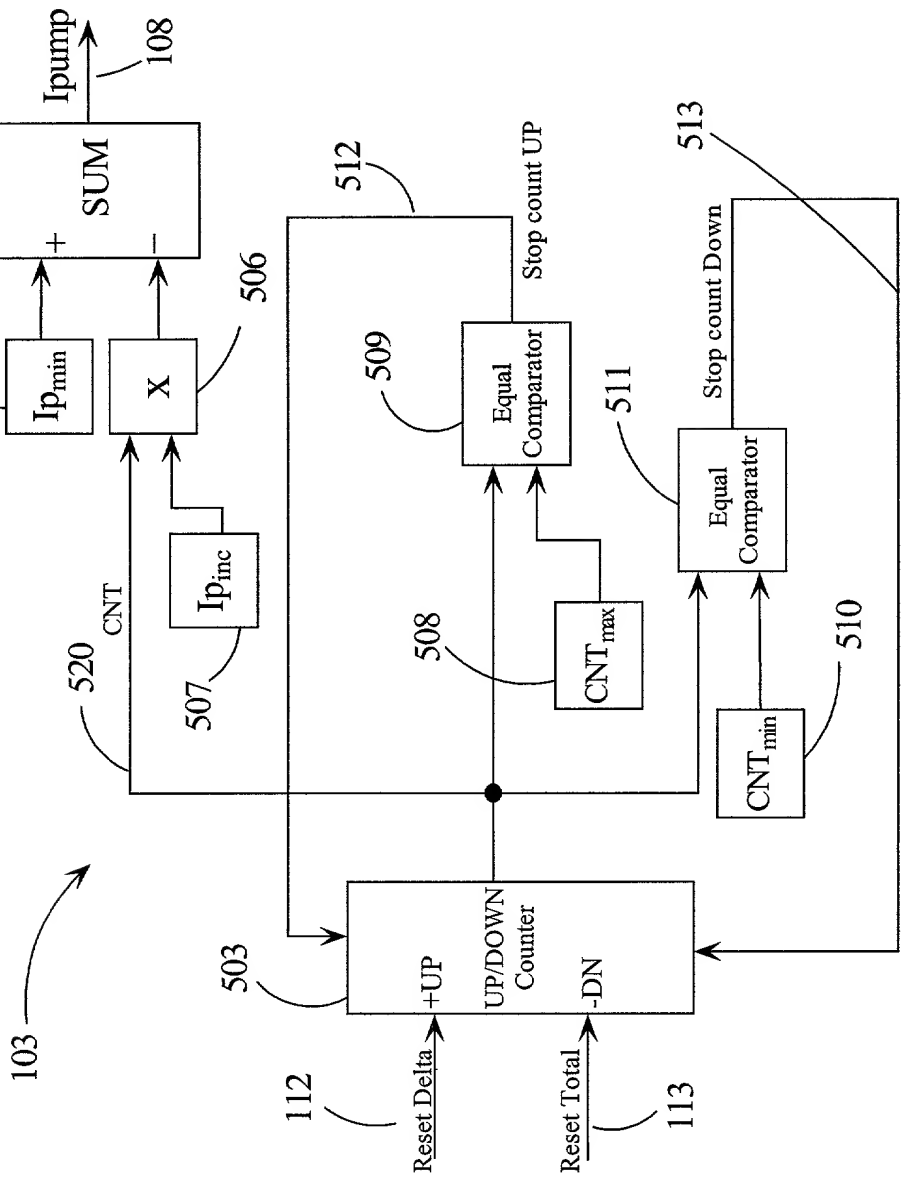
Ipump
108
505
SUM
+
−
504
Ip_{min}
x
506
512
Stop count UP
509
Equal Comparator
511
Stop count Down
513
Equal Comparator
Ip_{inc}
507
520
CNT
508
CNT_{max}
CNT_{min}
510
103
503
+UP
UP/DOWN Counter
-DN
112
Reset Delta
Reset Total
113

FIG. 5

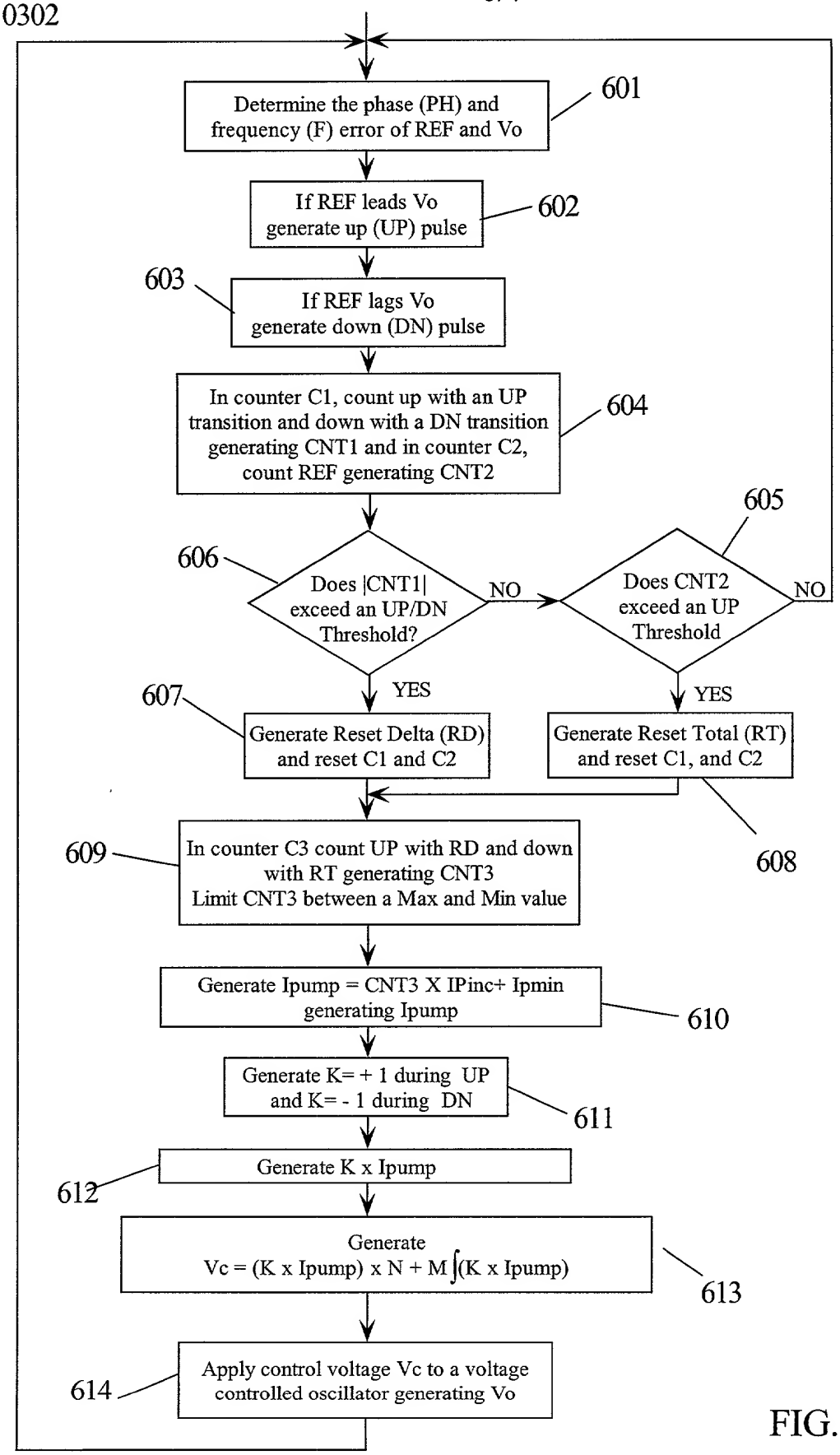
Determine the phase (PH) and frequency (F) error of REF and Vo
601
If REF leads Vo generate up (UP) pulse
602
603
If REF lags Vo generate down (DN) pulse
In counter C1, count up with an UP transition and down with a DN transition generating CNT1 and in counter C2, count REF generating CNT2
604
605
606
Does |CNT1| exceed an UP/DN Threshold?
NO
Does CNT2 exceed an UP Threshold
NO
YES
YES
607
Generate Reset Delta (RD) and reset C1 and C2
Generate Reset Total (RT) and reset C1, and C2
608
609
In counter C3 count UP with RD and down with RT generating CNT3
Limit CNT3 between a Max and Min value
Generate Ipump = CNT3 X IPinc+ Ipmin generating Ipump
610
Generate K= + 1 during UP and K= - 1 during DN
611
Generate K x Ipump
612
Generate
Vc = (K x Ipump) x N + M ∫(K x Ipump)
613
614
Apply control voltage Vc to a voltage controlled oscillator generating Vo

FIG. 6

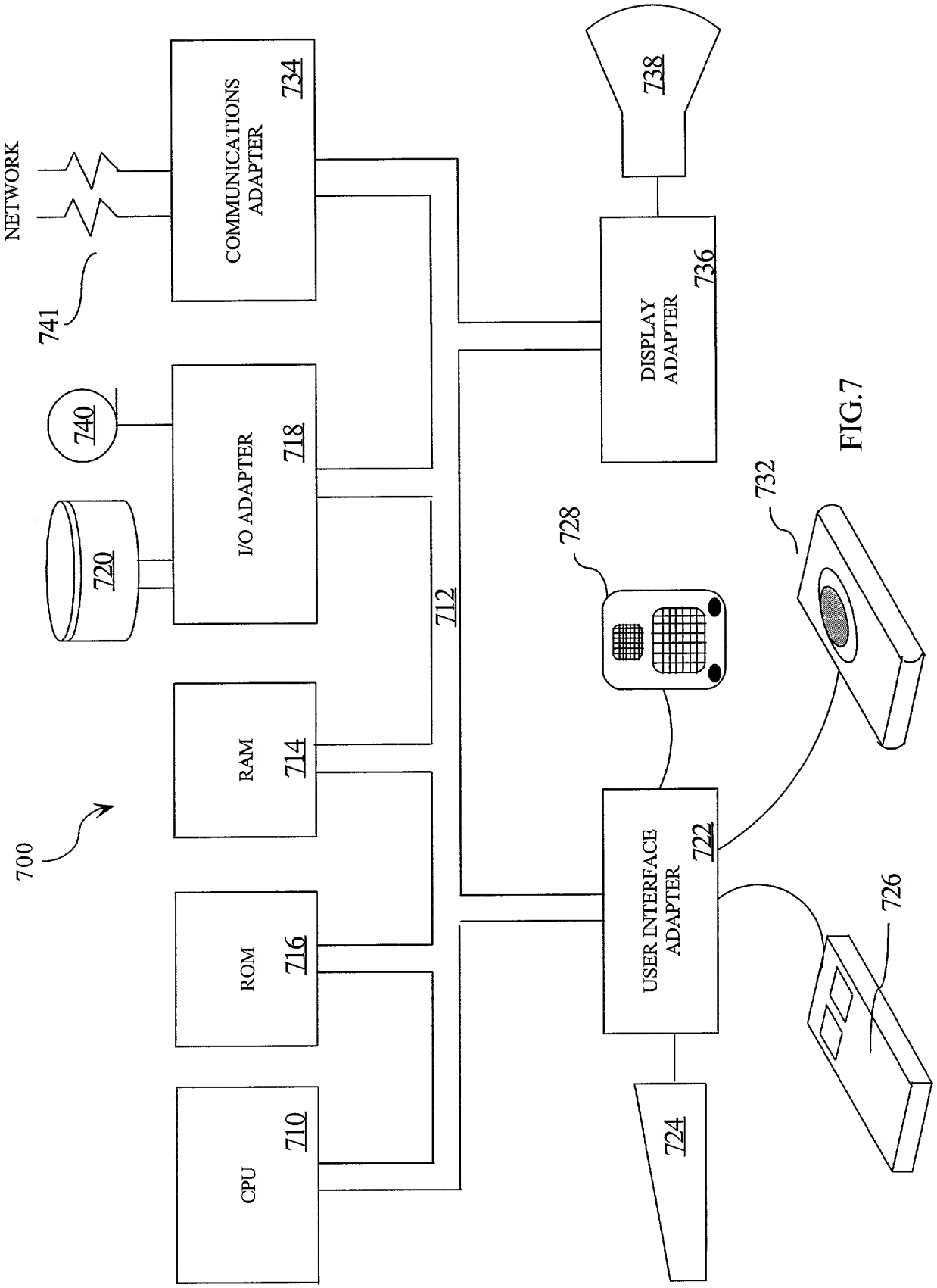
700
CPU
710
ROM
716
RAM
714
I/O ADAPTER
718
720
740
NETWORK
741
COMMUNICATIONS ADAPTER
734
712
738
DISPLAY ADAPTER
736
728
732
USER INTERFACE ADAPTER
722
724
726

FIG.7